

LDEF MATERIALS SPECIAL INVESTIGATION GROUP'S DATA BASES

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SUMMARY

The Long Duration Exposure Facility (LDEF) was composed of and contained a wide array of materials, representing the largest collection of materials flown for space exposure and returned for ground-based analyses to date. The results and implications of the data from these materials are the foundation on which future space missions will be built. The LDEF Materials Special Investigation Group (MSIG) has been tasked with establishing and developing data bases to document these materials and their performance to assure not only that the data are archived for future generations but also that the data are available to the space user community in an easily accessed, user-friendly form. This paper discusses the format and content of the data bases developed or being developed to accomplish this task. The hardware and software requirements for each of the three data bases are discussed along with current availability of the data bases.

INTRODUCTION

The LDEF MSIG was charged with the task of establishing and developing electronic data bases which could eventually contain the wide variety and vast quantity of materials data being generated by the MSIG members and other LDEF investigators (ref. 1, 2). The MSIG chose to accomplish this task by a three-pronged approach. The first approach utilized a preexisting global-access data base system, the Materials and Processes Technical Information System (MAPTIS), as the host for the LDEF Materials Data Base. The second approach was to build on the Optical Materials Data Base developed by the Boeing Defense and Space Group under the auspices of the Systems Special Investigation Group (SSIG) (ref. 3). The Optical Materials Data Base was expanded and four other PC/Macintosh (MAC) software-based data bases, commonly referred to as "minidata bases," were developed by the Langley Research Center. The third approach was to

develop a version of the LDEF Materials Data Base for use with PDA Engineering's M/VISION™ software. An overview of the capabilities and requirements of the M/VISION™ software and this version of the LDEF Materials Data Base will be discussed. Information on availability and how to access these data bases are given. The future plans for developing these data bases are discussed.

MAPTIS LDEF MATERIALS DATA BASE

The Materials and Processes Laboratory management at NASA/Marshall Space Flight Center agreed to incorporate the LDEF Materials Data Base as a part of their automated storage, retrieval, and display data base system. The preliminary version of the LDEF Materials Data Base was released to the user community in June of 1992, and an updated version is currently available to all interested parties in the International Space Materials Community. The goal of MAPTIS is to provide an efficient, reliable means of supplying the information needed for the selection and application of materials and processes to produce the hardware required for NASA's and industry's current and future space missions. MAPTIS uses an ORACLE Corporation Relational Data Base Management System and can be accessed via a modem and a 1-800 telephone number or via Telnet. Users can access MAPTIS using hardware that emulates a Digital Equipment Corporation (DEC) VT100 terminal. The LDEF Materials Data Base is one of several different data bases in MAPTIS.

After reviewing comments and suggestions from the LDEF user community, the main menu of the LDEF Materials Data Base was restructured to make the data base more flexible in terms of format. A number of new types of searches and report formats is now available. New main menu options are now divided into six categories as listed below:

- **LDEF Materials Listing**—returns a list of all known materials flown on or as part of LDEF that meet the user's search criteria, detailing which experiment(s) it was flown on and whether property data on that material are currently in the data base. Search options include materials code, use type designation, composition, specification(s), manufacturer/supplier, and experiment number.
- **Basic Data Search**—returns all basic data (material code, manufacturer, designation and composition, etc.) on all materials meeting the user's search criteria. Search options include material code, use type, designation, composition, specification, and manufacturer/supplier.
- **Property/Value Search**—searches by property and user specified property value regardless of other data. Search options include 26 different properties currently on the data base, and this list will expand as new properties are added.
- **All Data Search**—returns all available data on materials that meet the user's search criteria, including property and value, location, atomic oxygen (AO) flux and fluence values, estimated Sun hours, etc. Search options include all available properties, material code, use type, designation, composition, specification, manufacturer/supplier, experiment number, location on the satellite, estimated Sun hours, AO flux exposure, angle of AO incidence values, and sources from which the data have been taken.
- **Data Source Searches**—searches for a source by data source number, primary facility or organization conducting the testing, author(s) of the published paper or principal investigators, or by the document title of the published paper.

There are slight differences in search criteria options from one area to the next, but the user is allowed to enter from three to five search criteria options in most areas of the data base. This helps maintain the data base's search flexibility. On-line help screens are now available throughout the LDEF Materials Data Base. These screens show the input information required for a specific option and the information included in the output.

This data base is a growing entity. As more published and unpublished data become available it will be incorporated. Feedback from the user community is appreciated so that this data base will become an indispensable tool for both space researcher and spacecraft designer. The primary purpose of this data base is to become the central storage point for the vast amount of data so that its results will not be lost to future researchers, engineers, and designers in the aerospace industry.

M/VISION™

M/VISION™ is a materials software system that allows for the capture, organization, and visualization of materials engineering data. M/VISION™ allows the user to reduce, manipulate, query, and graph materials data. The software includes graphics, spreadsheet, imaging, and modeling capabilities as well as data basing capabilities. Multiple data types, such as tabular data, graphs, and raster images can be stored in a single data base. M/VISION™ is a hybrid hierarchical/relational data base with both hierarchical and standard Structure Query Language interfaces. An integrated engineering spreadsheet is included in the software that allows the user more efficient means to manipulate and visualize the information in the data base. Data bases can be manipulated via user written FORTRAN and C codes.

The M/VISION™ software is configured to run on UNIX workstation computers by Hewlett-Packard, Silicon Graphics, SUN, and IBM. It is also configured to run on DEC computers running VMS and ULTRIX™. The software operates in the X-Windows environment with any networked X device such as a PC or MAC using X emulation software. In the VMS environment, the software supports both DEC Windows/Motif and TEK devices.

M/VISION™ LDEF MATERIALS DATA BASE

In the late spring of 1993, the LDEF Materials Data Base that runs on the M/VISION™ software will be available to users in the International Space Materials Community to run on their own licensed M/VISION™ software. A very preliminary version of the data base in the M/VISION™ format was demonstrated at the LDEF Materials Results for Spacecraft Conference. Figure 1 is a depiction of the M/VISION™ data base window overlaid with a spread-sheet window. In the data base display, the user has already made several choices such as the materials, environment, descriptors, and experiment, which are shown at the far right of the display. The main portion of the data base window displays the source and reference of the data. The actual data are displayed on a previous screen. The spreadsheet illustrates the direct connection between the spreadsheet and the data base. In this example spreadsheet, the user requested that all materials with “*934*” in the designation, which had mass loss data in terms of percent total loss and had an AO value, be displayed along with the property name, qualifier, postflight value of the total mass loss, and AO flux. The spreadsheet automatically calculated the log of the AO flux and displayed it in column F. The data shown in the spreadsheet can then be plotted for a variety of materials, which would allow visualization of data trends. This is one example of data in the data base being manipulated by the

spreadsheet and then plotted for the user's easier visualization of the data and data trends. The spreadsheet can be stored and used as a template for future comparisons.

COMPARISON OF THE MAPTIS AND M/VISION™ VERSION OF THE LDEF MATERIALS DATA BASE

The users of the LDEF Materials Data Base have a wide range of computer hardware, software, and expertise. The two versions of the LDEF Materials Data Base require different hardware and software with accompanying levels of computer expertise. By offering the user a choice of these two versions of the data base, users may tailor their investment in hardware, software and time. The MAPTIS™ version of the data base requires relatively inexpensive computer hardware and software and allows the user to search and retrieve tabular data. The M/VISION™ version of the LDEF Materials Data Base requires the user to have more sophisticated hardware and software allowing the user to manipulate and analyze the data. Once the M/VISION™ version of the data base is transferred to the user's local machine, the data base requires only local access by the user and is available to any local networked X device. The user can incorporate in-house data or data from other sources into the data base. Both versions of the LDEF Materials Data Base are available at no charge.

MINIDATA BASES

The Boeing Defense and Space Group, which is under contract to the SSIG and MSIG, has developed a series of data bases containing results from LDEF. These data bases were developed to provide the user community with early access to LDEF data. The data bases were developed for use with PC and MAC versions of the Claris Corporation's Filemaker Pro™ software. Filemaker Pro™ is a flat file data base which allows the user to retrieve multiple data types such as tabular data, test, graphs, diagrams, and/or picture files. The data bases' simple interface allows for easy use by novice users. The individual data bases are password protected, allowing the user full access privileges to read, print, or download the data but not allowing the user to edit the data files. The software allows the user to search and retrieve specific information in a variety of layouts. Data can be exported to a variety of formats including ASCII. As with other data bases, all data are traced back to their original data source. A more detailed report of the capabilities of these minidata bases can be found in reference 3.

The minidata bases cover the optical materials, silverized Teflon™ thermal blankets, treated aluminum hardware, thermal control paints, and the LDEF environments areas of interest. The Optical Materials Data Base is a compilation of the results on the optical materials flown on LDEF and was originally developed by the SSIG. The silverized Teflon™ thermal blankets data base covers the results from the silverized Teflon™ thermal blankets utilized on LDEF. The treated aluminum hardware data base is a compilation of data from the various types of aluminum hardware flown on LDEF including different alloys, surface conditions, etc. The thermal control paints data base contains information on the wide variety of paints flown on LDEF. The LDEF environments data base contains information on the environment that LDEF was exposed to, including thermal profiles, solar UV irradiation, and AO exposure levels. Final versions of these data bases will be available by October 1993.

AVAILABILITY OF THE DATA BASES

For those parties interested in accessing the MAPTIS™ version or the M/VISION™ version of the LDEF Materials Data Base, contacts should be made with the second author, Joan Funk, or the third author, John M. Davis. Free copies of the LDEF minidata bases will be available through December 1994 by sending a written request including which format (PC or MAC) is being requested with a blank 3.5-in floppy disk for each data base to: Gary Pippin, Technical Lead LDEF Materials Data Analysis, Boeing Defense and Space Group, P. O. Box 3999, M/S 82-32, Seattle, WA 98124-24999. After that time the data bases will be available from NASA.

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REFERENCES

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2. Levine, A.S.: "LDEF—69 Months in Space: First Post-Retrieval Symposium." NASA CP-3134, June 1991.
3. Bohnhoff-Hlavacek, G.: "Data Bases for LDEF Results." Second LDEF Post-Retrieval Symposium, NASA CP-3194, 1993.

TEST>> FILE SCHEMA DATABASE GRAPHICS RUN
 TEST RUNS> SPREADSHEET IMAGING END

APPLICATION MATERIAL DESCRIPTORS
 EXPERIMENTAL DATA ORIGIN FACILITY DOC-TYPE
 BOEING DEFENSE AND TECHNICAL PAPER
 SPACE GROUP PRESENTED AT LDEF
 SYMPOSIUM, JUNE
 1991

USE TYPE COMPOSITE
 DESG 934 EPOXY T300
 GRAPHITE
 GRP N
 COMM 934 EPOXY T300
 GRAPHITE
 PROP NAME MASS CHANGE
 QUALIFE % TOTAL LOSS
 R
 EXPERIME H50033-8
 NT
 LOCATION D3
 MTRL EXPOSED SIDE
 SIDE
 ESH 11100, HRS
 FLUX 4.0E-5 ATOMS SQ CM*2
 TIME 5.77 YRS
 E EV 5 (0 V)
 EXP SAMPLE WAS
 THERMALLY
 CYCLED PRIOR
 TO FLIGHT

UTILITIES STOP

1	2	3	4	5	6	7	8	9	10	11	12	13	14
DESIG	A	B	C	D	E	F	G	H	I	J	K	L	M
1	934 epoxy/T300 graphite												
2													
3	DESIG LIKE "934" AND PROP NAME	LIKE "MASS" AND QUALIFIER LIKE "TOTAL LOSS" AND FLUX EX											
4	DESIG	PROP NAME LIKE	QUALIFIER	POST FLT	FLUX	Log (FLUX)							
5	934 epoxy/T300 > MASS CHANGE	% TOTAL LOSS	0.28		6.30E-13	13.961							
6	934 epoxy/T300 > MASS CHANGE	% TOTAL LOSS	0.28		4.06E-15	4.369							
7	934 epoxy/T300 > MASS CHANGE	% TOTAL LOSS	0.29		4.06E-15	4.369							
8	934 epoxy/T300 > MASS CHANGE	% TOTAL LOSS	0.31		6.30E-13	13.961							
9													
10													
11													
12													
13	p1700 polysulfone/T300 graphite												

Figure 1. An example of the data base and spreadsheet screens of the M/VISION™ version.